CHAPTER 13

SUPPORT AND MOVEMENT

MULTIPLE CHOICE QUESTIONS

Each question has four possible answers. Circle the correct answer

Act of changing place or position by entire body or its parts:

(a) Locomotion (b) Movement (c) Support (d) Coordination

Skeleton provides:

(a) Physical support (b) Attachment for muscles

(c) Protection for the bodies of animals (d) All of these

The cells of cartilage are called:

(a) Osteocytes (b) Chondrocytes (c) Erythrocytes (d) Leucocytes

Type of cartilage in inter-vertebral discs:

(a) Hyaline (b) Elastic (c) Fibrous (d) None of these

Hardest connective tissue in the body:

(a) Bone (b) Cartilage (c) Tendon (d) Ligament

The interior part of bone which is soft and porous is called:

(a) Compact bone (b) Spongy bone (c) Tendon (d) Cartilage

Spongy bone contains:

(a) Blood vessels (b) Bone marrow (c) Both a & b (d) None of these

Number of bones in a baby:

(a) 190 (b) 206 (c) 300 (d) 256

Mature bone cells are called:

(a) Thrombocytes (b) Chondrocytes (c) Erythrocytes (d) Osteocytes

Date of birth of Andreas Vesalius:

(a) 1510 (b) 1512 (c) 1514 (d) 1516

Total number of bones in axial skeleton:

(a) 60 (b) 80 (c) 70 (d) 90

Number of cranial bones:

(a) 8 (b) 10 (c) 12 (d) 14

Number of facial bones:

(a) 12 (b) 14 (c) 16 (d) 18

(14) Total middle ear ossicles in human body:

(a) 3 (b) 6 (c) 9 (d) 12

(15) Number of pairs of ribs in human skeleton:

(a) 6 (b) 12 (c) 18 (d) 24

(16) Total number of bones in both hands:

(a) 14 (b) 28 (c) 42 (d) 56

(17) Number of bones in each foot:

(a) 56 (b) 42 (c) 28 (d) 14

(18) The longest bone in our body:

(a) Thigh bone (b) Hand bone (c) Foot bone (d) Hip bone

(19) The upper jaw is fixed with:

(a) Vertebral column (b) Skull (c) Both a & b (d) None of these

(20) Example of ball-and-socket joint:

(a) Skull (b) Vertebrae (c) Elbow (d) Hip

ANSWER KEY

Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans
1	b	2	d	3	b	4	c	5	a
6	b	7	c	8	c	9	d	10	c
11	b	12	a	13	b	14	b	15	b
16	d	17	c	18	a	19	b	20	d

SHORT QUESTIONS

Q. No. 1 Why organisms need support?

NEED OF SUPPORT

The organisms with greater sizes need support to keep their body mass as one unit. This is particularly true for organisms that live on land.

Q. No. 2 What is movement?

MOVEMENT

The act of changing place or position by entire body or its parts of an organism is called movement.

Types of movement:

There are two types of movement:

- Movements of body parts
- Locomotion

Q. No. 3 Define locomotion.

LOCOMOTION

The movement of an animal as a whole from one place to another is called locomotion.

Q. No. 4 Define skeleton.

SKELETON

The framework of hard articulated structures that provides physical support, attachment for skeletal muscles and protection for the bodies of animals is called skeleton.

Q. No. 5 What are the advantages of skeleton? Or What does skeleton provide?

ADVANTAGES OF SKELETON

The skeleton provides:

- Physical support
- Attachment for skeletal muscles
- Protection for the bodies of animals

Q. No. 6 What is the difference between endoskeleton and exoskeleton?

DIFFERENCE BETWEEN ENDOSKELETON AND EXOSKELETON

Endoskeleton	Exoskeleton
Definition: The skeleton which is inside of the body is called endoskeleton. ***Example:*** • Man	***Definition:*** The skeleton which is on the outside of the body is called exoskeleton. ***Example:*** • Arthropods

Q. No. 7 What is the role of skeletal system?

ROLE OF SKELETAL SYSTEM

The big functions of the skeletal system are:

Protection:

Skeleton provides protection to many internal organs. For example:

- Skull protects brain
- Vertebral column protects spinal cord
- Ribs protect most of the internal organs

Support:

Vertebral column provides the main support to the body mass.

Movements:

In our body, skeleton works very closely with the muscular system to help us move.

Q. No. 8 What are tendons and ligaments?

TENDONS AND LIGAMENTS

Tendons and ligaments are a type of connective tissues that contain tightly packed collagen fibres.

Q. No. 9 How many bones are present in a baby and an adult?

NUMBER OF BONES

The babies are born with about 300 soft bones. Some of these bones later fuse together, so that the adult skeleton has 206 hard bones.

Q. No. 10 What is the contribution of Andreas Vesalius?

CONTRIBUTION OF ANDREAS VESALIUS

Period: 1514 – 1564

Place of Birth: He was born in Brussels, Belgium.

Contribution:

He is honoured for developing modern anatomical studies. He made many discoveries in anatomy, based on studies made by dissection of human dead bodies.

Book Contents:

His book contained the most accurate depictions of the whole skeleton and muscles of the human body.

Q. No. 11 Which one is the longest bone in the body?

LONGEST BONE

The thigh bone is the longest bone in the body.

Q. No. 12 Discuss the evolution of ear bones and jaws in mammals.

EVOLUTION OF EAR BONES AND JAWS IN MAMMALS

The upper jaw is fixed with the skull and is composed of two bones. The lower jaw is mobile and articulates with the skull. In lower vertebrates, the lower jaw is made up of more than one bone while in mammals, it is made up of single bone.

During evolution, mammals modified the lower jaw bones and incorporated four of them into the middle ear (in the form of malleus and incus in both ears). This adaptation proved beneficial for mammals. Lower jaw with single bone is stronger and the malleus and incus also improve hearing

Q. No. 13 What do you know about the movement of neck joint?

MOVEMENT OF NECK JOINT

The neck joint between vertebral column and head allows movements side to side.

Q. No. 14 Can muscles push?

No, muscles can not push. The muscles can only pull or contract.

Q. No. 15 Write some activities that require combined action of several muscles.

Most activities in our body require combined action of several muscles, like:

- Walking
- Running
- Playing

Q. No. 16 Why incidence of osteoporosis is more common in old females?

OSTEOPOROSIS IN OLD FEMALES

It is one of the functions of estrogen to deposit minerals in bones. In old age, when the reproductive cycle stops in females, not enough estrogen is secreted.

Q. No. 17 Which point of attachment is pulled when a muscle contracts?

Insertion is pulled when a muscle contracts.

LONG QUESTIONS

Q. No. 1 Write a note on cartilage.

CARTILAGE

Introduction:
Cartilage is a dense, clear, blue-white firm connective tissue.

Strength:
Cartilage is less strong than bone.

Chondrocytes:
The cells of cartilage are called chondrocytes.

Lacuna:
Each chondrocyte lies in a fluid space called lacuna present in the matrix of cartilage.

Collagen Fibres:
The matrix of the cartilage contains collagen fibres.

Blood Circulation:
Blood vessels do not enter into the cartilage.

TYPES OF CARTILAGE

There are three types of cartilage:

1. Hyaline Cartilage
2. Elastic Cartilage
3. Fibrous Cartilage

1. Hyaline Cartilage:
The hyaline cartilage is strong yet flexible.

Presence:
It is found in:

- Nose
- Larynx
- Trachea
- Bronchial tubes
- Covering the ends of the long bones

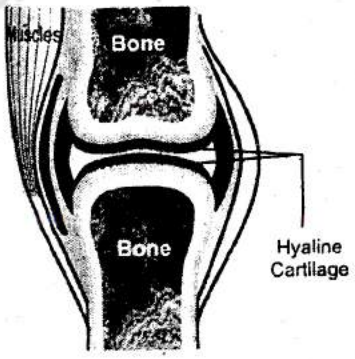


Figure: Hyaline Cartilage

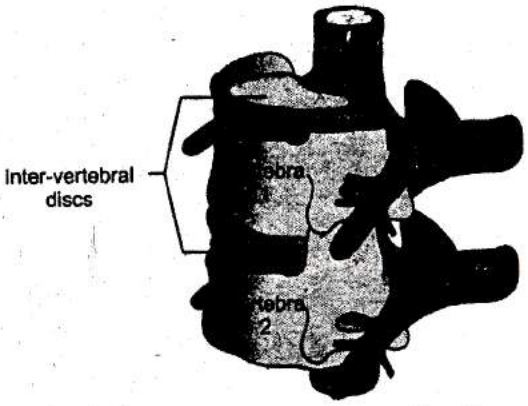


Figure: Fibrous Cartilage

2. Elastic Cartilage:
Elastic cartilage is similar in structure to the hyaline cartilage. It is also quite strong but has elasticity due to the network of elastic fibres in addition to collagen fibres.

Presence:

It is found in:

- Epiglottis
- Pinna

3. **Fibrous Cartilage:**

Fibrous cartilage is very tough and less flexible due to the large number of thick collagen fibres present in knitted form.

Presence:

It is found in:

- Intervertebral discs

Q. No. 2 Write a note on bone.

BONE

Bone is the hardest connective tissue in the body.

Compact Bone:

The hard outer layer of the bone is called compact bone.

Spongy Bone:

The interior of the bone is soft and porous and is called spongy bone. Spongy bone contains blood vessels and bone marrow.

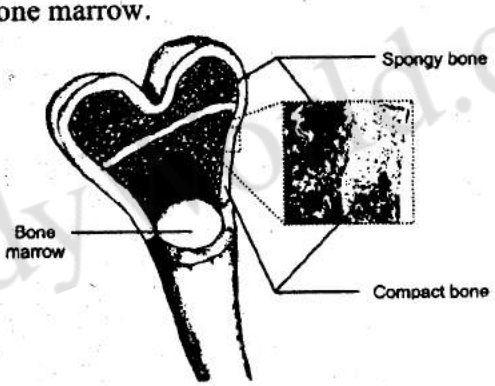


Figure: Compact and Spongy Bone

Composition of Matrix:

The matrix of the bones contains:

- Collagen
- Calcium
- Phosphate

Osteocytes:

Bone contains different types of cells. The mature bone cells are called osteocytes.

Number:

The babies are born with about 300 soft bones. Some of these bones later fuse together, so that the adult skeleton has 206 hard bones.

Functions:

The bones perform the following functions:

- Movement
- Support
- Protection
- Storage of minerals
- Production of red and white blood cells

Q. No. 3 Write a note on human skeleton.

HUMAN SKELETON

The 206 bones in the adult human skeleton are organized into the longitudinal axis i.e. axial skeleton, to which appendicular skeleton is attached.

AXIAL SKELETON

Number of Bones;

Axial skeleton consists of the 80 bones in the head and trunk of the body.

Parts of Axial Skeleton:

It is composed of five parts:

1. **Skull:**

   Skull contains 22 bones out of which 8 are cranial bones (enclosing the brain) and 14 are facial bones.

2. **Middle Ear Ossicles:**

   There are 6 middle ear ossicles (3 in each ear).

3. **Hyoid Bone:**

   There is a hyoid bone in the neck.

4. **Vertebral Column:**

   Vertebral column contains 33 bones (vertebrae).

5. **Chest:**

   The chest is made up of a chest bone calles sternum and 24 (12 pairs) ribs.

APPENDICULAR SKELETON

Number of Bones:

Appendicular skeleton is composed of 126 bones.

Pectoral Girdle:

Pectoral (shoulder) girdle is made up of 4 bones.

Arms:

Arms have 6 bones.

Hands:

Both hands have 56 bones.

Pelvic Girdle:

Pelvic girdle (hips) has 2 bones.

Legs:

Legs have 8 bones.

Feet:

Both feet have 56 bones.

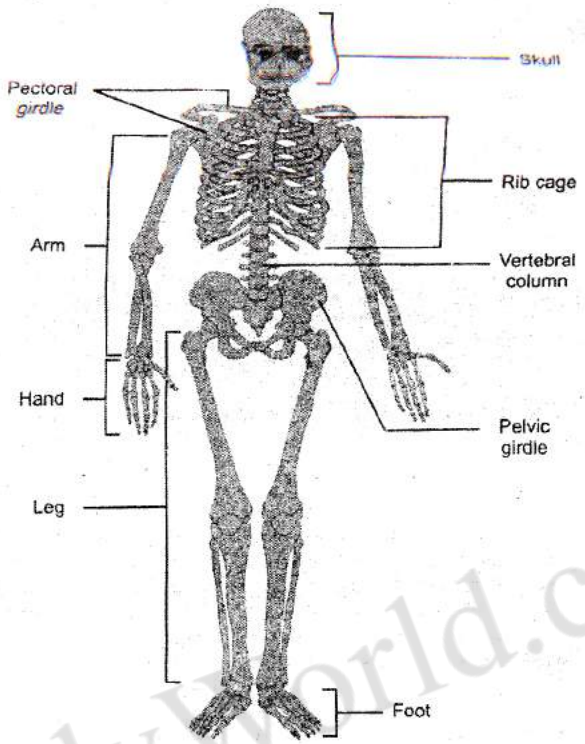


Figure: Human Skeleton

Q. No. 4 What is a joint? Explain different types of joints.

JOINT

Definition:

The location at which two or more bones make a contact is called as joint.

Functions:

The joints:

- Allow movement
- Provide mechanical support

Basis of classification:

The joints can be classified on the basis of the degree of movement they allow.

Types of joints

Following are the three main types of joints:

1. Immovable (fixed) Joints
2. Slightly Movable Joints
3. Movable Joints

1. **Immovable (fixed) Joints:**
   Such joints allow no movement.
   Example:
   - Joints between the skull bones

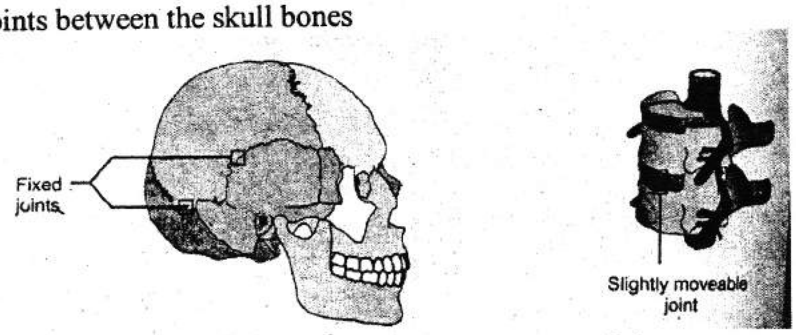


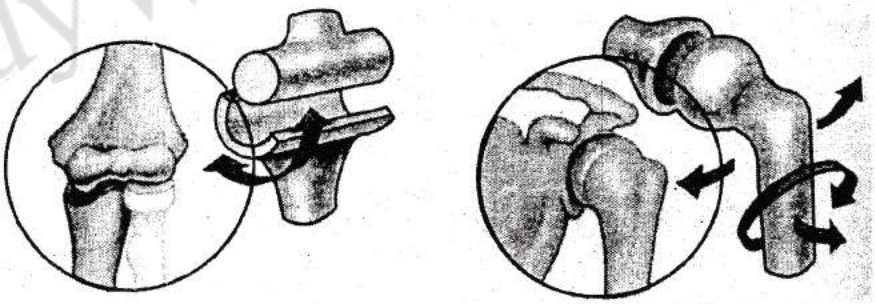
Figure: Fixed and Slightly Moveable Joints

2. **Slightly Movable Joints:**
   Such joints allow slight movements.
   Example:
   - Joints between the vertebrae

3. **Movable Joints:**
   They allow a variety of movements. There are many types of movable joints in the body. The main types are as follow:

Hinge Joints:
These joints move back and forth like the hinge on the door and allow movements in one plane only.

Examples:
- Knee joint
- Elbow joint



Hinge Joint **Ball-and-Socket Joint**

Figure: Two Types of Moveable Joints

Ball-and-Socket Joints:
These joints allow movements in all directions.

Examples:
- Hip joint
- Shoulder joint

Q. No. 5 Explain the roles of tendons and ligaments.

ROLE OF TENDONS AND LIGAMENTS

Introduction:

Tendons and ligaments are bands of connective tissues.

Composition:

These are made of collagen.

Tendons:

Tendons are tough bands and attach muscles to bones.

Function:

When a muscle contracts tendon exerts a pulling force on the attached bone, which moves as a result.

Ligaments:

Ligaments are strong but flexible bands and join one bone to another at joints.

Function:

They prevent dislocation of bones at joints.

Q. No. 6 **Explain the action of antagonist muscles at elbow joint.**

ACTION OF ANTAGONIST MUSCLES AT ELBOW JOINT

Movements in Bones:

The movements in bones are brought about by the contractions of skeletal muscles, which are attached with them by tendons.

Origin:

One end of a skeletal muscle is always attached with some immovable bone. This end of muscle is called the origin.

Insertion:

The other end of the muscle is attached with a movable bone and is called the insertion.

Contraction of Muscle:

When a muscle is stimulated by a nerve impulse, it contracts to become shorter and thicker. Due to its contraction, it pulls the movable bone.

Antagonism:

Skeletal muscles are usually in pairs of antagonists. In the antagonist pair, both muscles do opposite jobs. When one muscle contracts the other relaxes and this phenomenon is known as antagonism.

Flexor:

When a muscle contracts and bends the joint, it is known as flexor muscle.

Flexion:

This bending movement done by flexor muscle is called flexion.

Extensor:

When a muscle contracts and straightens the joint, it is known as extensor muscle.

Extension:

This straightening movement done by extensor muscle is called extension.

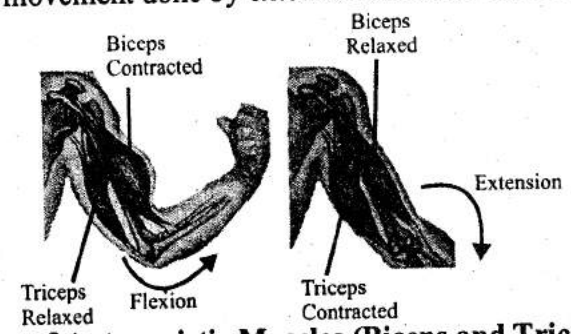


Figure: Action of Antagonistic Muscles (Biceps and Triceps) at Elbow

Biceps:

Biceps is a flexor muscle on the front of the upper arm bone.

Triceps:

Triceps is an extensor muscle on the back of arm.

Origin and Insertion:

Both these muscles have their origin at pectoral girdle and insertion at one of the two bones of forearm.

Contraction of Biceps:

When biceps contracts, the forearm (insertion end) is pulled upward. It is the flexion of elbow joint. During this flexion, triceps muscle relaxes.

Contraction of Triceps:

When triceps muscle contracts, forearm is pulled down. It is the extension at elbow joint. During this, biceps muscle relaxes.

Antagonistic Pair of Muscles:

In this way, biceps and triceps make up an antagonist pair of muscles. Similar pairs, working antagonistically across other joints, provide for almost all the movements of skeleton.

Q. No. 7 Write a note on osteoporosis.

OSTEOPOROSIS

Introduction:

Osteoporosis is the bone disease in adults, especially in old people. It is more common in old women.

Symptom:

In osteoporosis, there is a decrease in the density of bones due to the loss of calcium and phosphorus.

Causes:

It may be due to:

- Malnutrition
- Lack of proteins and vitamin C
- Lack of physical activities
- Deficiency of estrogen hormone

Old Age:

In old age, there is decreased secretion of growth hormones and it also leads to decreased deposition of minerals in bone matrix.

Q. No. 8 Write a note on arthritis.

ARTHRITIS

Meaning:

Arthritis means "inflammation of joints".

Victims:

It is very common in old age and in women.

Symptoms:

It is characterized by:

- Pain
- Stiffness in joints

Most Affected Joints:

The most affected joints are the weight bearing joints. For example:

- Hip joint
- Ankle joint

TYPES OF ARTHRITIS

There are many types of arthritis. Some are as follow:

1. Osteo-arthritis
2. Rheumatoid Arthritis
3. Gout

1. Osteo-arthritis:

Causes:

It is due to:

- Degeneration in the cartilage present at joints
- Decreased lubricant production at joints

Outcomes:

In this arthritis, fusion of bones at joints may occur and joints may become totally immovable.

2. Rheumatoid Arthritis:

It involves the inflammation of the membranes at joints.

Symptoms:

Its symptoms include:

- Fatigue
- Low grade fever
- Pain in joints
- Stiffness in joints

3. Gout:

It is characterized by the accumulation of uric acid crystals in movable joints. It generally attacks the toe joints.

MULTIPLE CHOICE QUESTIONS

1. **Find the ball-and-socket joint.**
   (a) Joint in the finger bones
   (b) Joint of neck and skull bones
   (c) Joint at elbow
   (d) Joint at pelvic girdle and leg bones
2. **All these are the parts of axial skeleton of humans except:**
   (a) Ribs
   (b) Sternum
   (c) Shoulder girdle
   (d) Vertebral column
3. **The disorders in which there is an accumulation of uric acid in joints:**
   (a) Gout
   (b) Rheumatoid arthritis
   (c) Osteoporosis
   (d) Osteo-arthritis
4. **What is correct about tendons?**
   (a) Tendons are flexible and they join muscles with bones
   (b) Tendons are non-elastic and they join bones with bones
   (c) Tendons are non-elastic and they join muscles with bones
   (d) Tendons are flexible and they join muscles with muscles
5. **How many bones make our skull?**
   (a) 14
   (b) 22
   (c) 24
   (d) 26
6. **What are the main components of a bone?**
   (a),Marrow, spongy bone, wax
   (b) Marrow, compact bone, wax
   (c) Compact bone and marrow
   (d) Compact bone, spongy bone, marrow
7. **What do some bones produce?**
   (a) Mucous
   (b) Hormones
   (c) Oxygen
   (d) Blood cells
8. **How would you define skeletal system?**
   (a) All the bones in body
   (b) All the muscles and tendons
   (c) All the body's organs, both soft and hard tissues
   (d) All the bones in body and the tissues that connect them
9. **Find the INCORRECT statement.**
   (a) Bone is where 'most blood cells are made
   (b) Bone serves as a storehouse for various minerals
   (c) Bone is a dry and non-living supporting structure
   (d) Bone protects and supports the body and its organs
10. **The purpose of rib cage is to:**
   (a) Protect the stomach
   (b) Protect the spinal cord
   (c) Protect the heart and lungs
   (d) Provide an object to which the lungs can attach

ANSWER KEY

Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans
1	d	2	c	3	a	4	c	5	b
6	d	7	d	8	d	9	c	10	c

SHORT QUESTIONS

1. Differentiate between cartilage and bone

Cartilage	Bone
Introduction: Cartilage is a dense, clear, blue-white firm connective tissue.	***Introduction:*** Bone is the hardest connective tissue in the body.
Strength: Cartilage is less strong than bone.	***Strength:*** Bone is more strong than cartilage.
Chondrocytes: The cells of cartilage are called chondrocytes.	***Osteocytes:*** Bone contains different types of cells. The mature bone cells are called osteocytes.
Types: • Hyaline Cartilage • Elastic Cartilage • Fibrous Cartilage	***Types:*** • Compact Bone • Spongy Bone

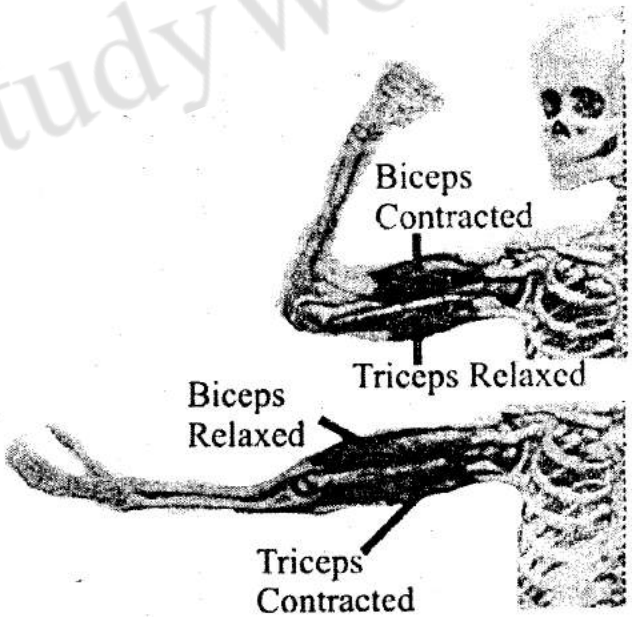
2. What is the role of skeleton in support and movement?

Consult Short Question No. 7

3. How would you differentiate between osteoporosis and arthritis?

Consult Long Question No. 7 and 8

4. Label the biceps and triceps in the following diagrams and also mention their contracted or relaxed states.



UNDERSTANDING THE CONCEPT

1. **What are the main components of the axial skeleton and the appendicular skeleton of human?**

Consult Long Question No. 3

2. **Describe the types of joints and give examples.**

Consult Long Question No. 4

3. **What are ligaments and tendons? What function do they perform?**

Consult Long Question No. 5

4. **Explain antagonism in muscle action selecting biceps and triceps as example.**

Consult Long Question No. 6

THE TERMS TO KNOW

Antagonism:
Skeletal muscles are usually in pairs of antagonists. In the antagonist pair, both muscles do opposite jobs. When one muscle contracts the other relaxes and this phenomenon is known as antagonism.

Appendicular Skeleton:
The division of the skeleton that includes arms, hands, legs, feet, pectoral girdle and pelvic girdle

Arthritis:
Term used for the inflammation of the joints

Axial Skeleton:
The division of the skeleton that includes the skull, vertebral column, ribs and breast bone

Ball-and-Socket Joint:
The joint that allows movement in all directions e. g. hip and shoulder joints

Biceps:
A flexor muscle on the front of the upper arm bone

Bone:
Hard connective tissue; moves, supports and protects the various organs of the body

Cartilage:
The connective tissue that makes part of the human skeleton

Chondrocytes:
The cells present in the cartilage

Compact Bone:
The hard outer layer of bones

Cranial Bones:
The bones in the cranium

Extensor:
A muscle that extends a joint

Fibrous Cartilage:
The cartilage that has large number of fibres in the matrix e. g. the cartilage in intervertebral discs

Flexor:
The muscle that bends a joint

Gout:
A type of arthritis, characterized by the accumulation of uric acid crystals in the movable joints

Hinge Joint:
A joint that permits movement of bones in one plane e. g. elbow and knee joints

Hyaline Cartilage:
The cartilage that has collagen fibres in its matrix; found covering the ends of long bones, in the nose, larynx, trachea and bronchial tubes

Insertion:
The end of the muscle that is attached with a movable bone

Joint:
The location at which two or more bones make contact

Lacuna:
The fluid filled space in bone and cartilage, where the cells are present

Ligament:
Strong but flexible connective tissue that joins one bone to bone at the joints

Origin:
The end of the muscle that is attached with the immovable bone

Osteoarthritis:
Inflammation in joints due to the degeneration of the cartilage present at the joints or due to decreased lubricant production at the joint

Osteocyte:
The mature bone cell

Osteoporosis:
A bone disease in adults, especially in old age, there is a decrease in the density of bones due to the loss of calcium and phosphorus

Rheumatoid Arthritis:
Painful inflammation of the membranes at the joints

Skeleton:
The framework of hard, articulated structures that provide physical support, attachment for skeletal muscles, and protection for the bodies of the animals

Spongy Bone:
The soft and porous interior of the bone; contains blood vessels and bone marrow

Sternum:
The chest bone

Tendon:
Tough connective tissue that attaches muscles to bones

Triceps:
Triceps is an extensor muscle on the back of arm.